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SYSTEMS FOR COMMUNICATING IDEAS PAST, PRESENT AND FUTURE

R.M. Field

Governor's Conference
on Libraries and
Information Services

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Preface

The purpose of this document is to describe present information handling systems — systems designed to communicate technical information from the originator(s) to the user(s) and to explore potential practical systems for the near - future (1985-90). To understand the present and the requirements for the future, a brief discussion of the past is presented as a reference point.

Concern for sources of information on a global basis is valid now that there are viable means of delivering that information to the requestor in a timely, economical, and convenient manner. The impact of sources of information on a regional, national, and global basis must be awesome to the librarian and virtually mindboggling to the requestor. When one considers the orders of magnitude possible in the increase of information available from multinational sources, the consequent impact must be overwhelming. Specialized systems, both existing and capable of being implemented, must be used to exploit information geographically separated from the point of need.

The history of communications is long and proud, particularly that of the technology that advanced the art and science. Indeed, the history of communications technology is as long and complex as the history of man himself. Communications history is still being made as new solutions to age-old problems of information preparation, retrieval, and dissemination are being explored. Satellites, facsimile transmission systems, interactive computer systems, word processing devices, and micropublishing techniques are all part of today's technology — and tomorrow's history.

The development of information communication systems was and is a complex process that evolved over hundreds of thousands of years. The factor that spurred the growth of the information base and the means of communicating this information is what I term the "Communications Cycle".

The Communications Cycle is an interlocked loop of three components vital to mankind:

- Knowledge
- The basic need to communicate that knowledge
- The means of communicating that knowledge

Indeed, the process is self-feeding much like that of a nuclear fast breeder reactor. Each component feeds the others and, in turn, each grows as a result of the other's growth.

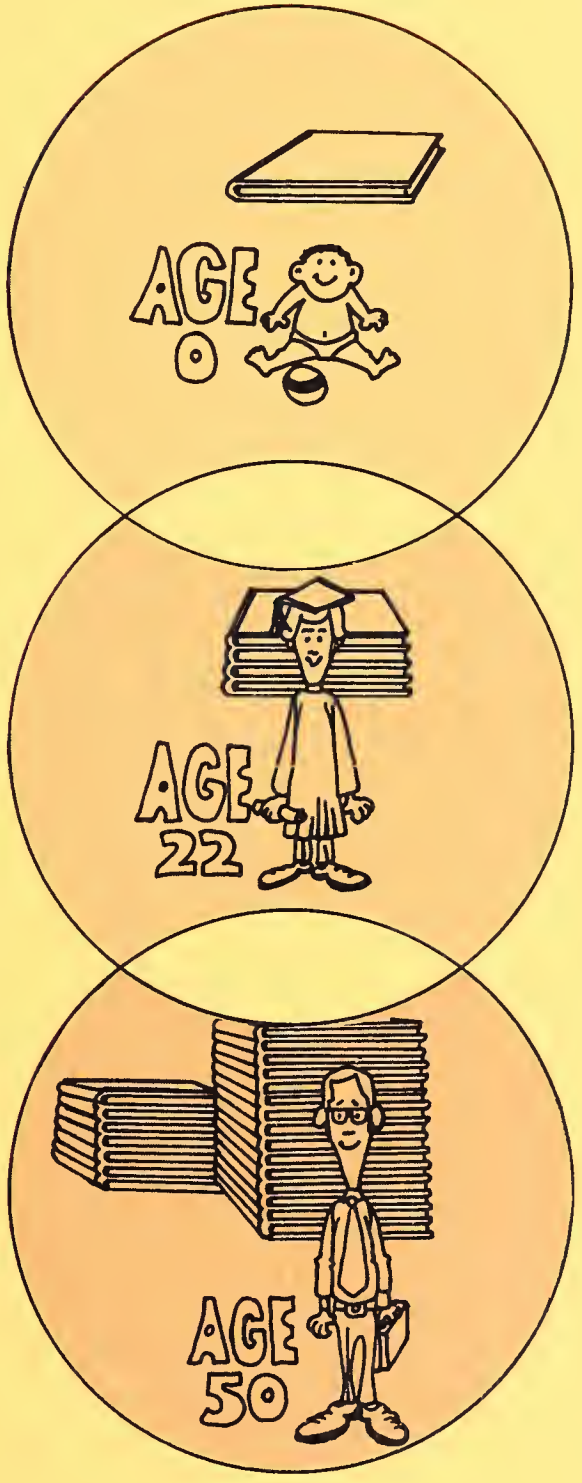
Introduction

The cycle has existed since earliest man imparted to his family his newly learned techniques of planting wild grain. The technique was his knowledge; the desire to survive, his need to communicate; a few grunts and gestures, his means of communicating. This was fine 70,000 years ago but just won't do in the modern world.

And why not? An interesting answer was brought to light recently by Dr. Robert L. Hilliard, an official of the Federal Communications Commission and president of the International University of Communication in Washington, D.C. Dr. Hilliard stated that at the rate which knowledge is growing, by the time a child born today graduates from college, the amount of knowledge in the world will be four times as great. By the time that same child is 50 years old, the amount of knowledge will be 22 times as great, and 97 percent of everything known in the world will have been learned since the time he was born!

Even if Dr. Hilliard's projections prove to be somewhat ambitious, we must improve the "means-of-communicating" link of the Communications Cycle to enable continued expansion of the information base.

The historic trend of communications systems has been to provide information in a smaller package, in less time, to more places, more economically than previous systems. We have come a long way down the path of communication progress from the first (technical) drawings in the caves of Lascaux and environs, to the present-day satellites, facsimile transmission systems, and interactive computer systems. It is more than likely that we will travel at least as far in the next few years.



In the history of mankind, many thousands of scientists and engineers have worked and communicated. Today, more than 90 percent of all who ever were so occupied are working and producing technical information. To be of value, this information must be communicated rapidly and on a broad scale.

The body of written and available knowledge grew slowly until the discovery of paper, type, and the printing press. Cities and universities were considered great as a direct function of the size of their library collections. The great libraries not only served as information repositories but also as research centers. Information for each scientific advance was made available worldwide in the form of text books, pamphlets, and instructions from these information repositories.

However, man was quickly buried in information of all kinds. Scientific, business, and general information was, and is, being generated at a rate faster than it could be handled. Because of this accelerating rate of the increase of pure knowledge, the "means-of-communicating" portion of the Communications Cycle was being overloaded by the "knowledge" and "need-to-communicate" portions. Clearly a problem was developing that would slow down the process. The following description briefly describes how mankind came to this hazard in the trail of progress.

When the first cave dwellers drew on the walls of Lascaux and Altamira about 20,000 BCE, little did they realize their efforts were the first in a long chain of communicating information. The bison and other animals drawn on the walls represent not only a decorative art form but a communicative one as well. The techniques were not primitive, for the drawings have lasted until today and are still available for viewing

by the general public after suitable arrangements have been made. For a moment, think not of the artisan but of the communicator. Mr. Caveman was telling a story to his fellow cave dwellers and to future generations. As he cut into the rock walls of the cave and then filled the grooves with pigment, Mr. Caveman pioneered the way for his descendants. He was establishing a process of communication that has lasted until this very day.

The problem with this form of communication is that the reader has to come to the mountain; the mountain is not easily transportable. The process scores high marks for durability and low marks for portability and accessibility.

A major milestone in communication was marked about 2250 BCE when cuneiform writing was introduced in Sumer. The Sumerians were prolific record keepers – probably the forerunners of our present day bureaucratic society – and maintained vast libraries and records repositories of clay bricks commonly called cuneiform tablets. These tablets marked one of the major breakthroughs in information and communications history. They were and are portable. Score high marks for durability (but not as high as for the cave drawings) and for portability, but only low medium for ease of preparation.

CLAY TABLET OF MIDDLE BABYLONIAN PERIOD
(Ca. 1400 BCE)

Written in Akkadian cuneiform, this text comes from the ancient site of Nuzzi, near modern Kirkuk, east of the Tigris. It is a business document recording a loan of grain taken by six men.

The photograph courtesy of Ken Cook Company, Milwaukee, Wisconsin.

The importance of the cuneiform tablet lies not so much in the story it tells of life 4200 years ago, but in its advance of the art and science of communication. No longer did man have to go to the mountain to see the written word (or drawing); rather the message could be brought or sent as desired. Permanent records replaced word of mouth for the first time.

Man now had a portable medium for communication. After a few hundred years, its drawbacks of weight, large numbers of tablets for a relatively brief message, relative brittleness, and large volume storage requirements soon led a search for an alternate and more portable medium. About 4000 years ago, papyrus and tanned animal hides were used in scrolls. Papyrus, because it was more abundant, lighter, and less subject to cracking, became the replacement medium for the cuneiform tablet, thus marking still another milestone.

The contributions of the papyrus scroll to communication were its relative flexibility, ease of distribution, relative high density of information in proportion to space occupied, and portability. The major shortcomings were its relatively rapid aging process, its need to be rolled rather than folded, and its stiffness or inflexibility compared to paper.

Paper came on the scene around 105 CE, after papyrus had been in general use for almost 1600 years. Therefore, paper in its many forms has been in use for about the same length of time that papyrus was the primary communications medium. Paper brought to communications even more flexibility, light weight, ease of storage, and ease of portability. In addition, paper 'ages' at a much slower rate than does papyrus.

The movable-type printing press, introduced in the mid-fifteenth century, provided the impetus to the information explosion. Now information could rapidly be duplicated in quantity, recorded, disseminated, used, stored, retrieved, and used again before previous systems could first "get the word" to the intended user. The press and paper combination could produce more in one day than a monastery of monks in a month, and with more accuracy. This was the breakthrough in the Communications Cycle that was needed to develop the arts and sciences and man's entire information base.

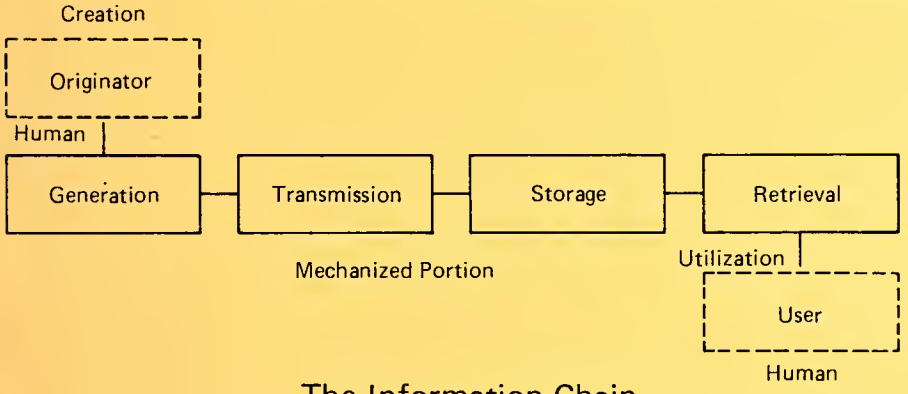
It has taken some 22,000 years to develop the present base of information from the early cave drawings in the mountains of Lascaux. In the next 22 years, we will quadruple the amount of information now available! Traditional systems and procedures will not suffice to make this information available to those who desire it. If it were not for the incredible advances in information and communications technology — based on miniaturization and electronics — we would be back at the mountain for all practical purposes. We must exploit these new systems and develop procedures to use our resources as they become available to effectively and economically distribute our knowledge.

Introduction

Just what do we mean when we discuss systems for communicating ideas? In my opinion, we are discussing combinations of newer and better tools to enable us to work smarter and more effectively. The key word here is *combination*. Combine two or more ordinary tools and — voilá — a system is born. In the simplest form, a pad and pencil, combined, provide a system for producing a written idea or bit of information. At one point in time this was revolutionary; today we must stop to consider whether our standard definition of the term system is met. One assumption is being made from this point on — that a human is the originator, or front end, of every system and also the user of every system discussed. Note, also, that virtually all of the systems discussed are electro-mechanical. Electronic technology has fostered the ability to communicate.

Many of our present tools, and therefore systems, are in a state of transition even now. Our pads and pencils, typewriters, the mail, and our bulky filing systems are being replaced by miniaturized dictation equipment systems, word processors, facsimile transmission equipment and microfilm or computer-based storage and retrieval systems. It is appropriate to identify some of the more common equipment types used to generate, transmit, store, and retrieve information. These very broad generic categories — generation, transmission, storage and retrieval — are the mechanized portions of the information cycle; the other two — creation and utilization — are human-related and are not pertinent to this discussion.

The description of these categories will vary in relation to the overall importance of that category in the communication system. Each category may be considered as a single block in a four-block chain but each is not equal among equals. As beauty is in the eye of the beholder, so is the relative



The Information Chain

importance of each block in the chain to the people directly involved in that area. For our purposes, we will consider generation the least important and transmission and storage and retrieval as equally important.

Generation Systems

Generation equipment and systems generally include the following:

- Word processing
- Automated graphic generators
- Black and white and color copiers
- Reproduction devices
- Microforms

Word Processing

Word processing is a broad term for a variety of systems that put words on paper and retain those words in a storage medium. Although word processing systems — from the simple stand-alone power typewriter to the ultra-complex computer-based system — affect all users of information, the process is not very well known. Perhaps these comments by Thomas P. Gerrity, Jr., President of Index Systems, Inc. of Cambridge, Massachusetts, provide an indication of the complexity of the subject:

- The idea is to take thought and put it down on paper as words in the most efficient manner possible.
- The premise is that what has to be done over and over again is done best by a machine.

With this lengthy introduction, the complexity of the subject should be readily apparent. There are literally dozens of firms which produce good stand-alone power typewriters; many of these units are now third-generation designs. If there are several dozen such firms, there are at least a dozen computer-based word processing systems available for the very large information-handling organizations. A reasonably comprehensive description of word processing devices in all forms would easily fill 1000 pages of text. Suffice it to state that the improved productivity of these devices when used in numbers greater than two is as dramatic as that of the typewriter vis-a-vis the pencil.

Automated Graphic Generators

Now that we have the words portion of our information base "down on paper", let's turn to the graphic portion; have we not been taught that a picture is worth a thousand words? This old cliche may be more true now than ever before, for our friends in the graphic arts have not been ignored in the exciting developments of the new electronic technology. Perhaps one of the more fascinating innovations of the past decade has been the development and implementation of computer-driven graphic generators. These systems usually consist of a computer, display device(s), and an indicator. The graphics specialist (and an experienced artist/designer is required) can communicate with the computer directly using a standard keyboard or in more advanced systems a light pen and keyboard.

This interactive design process allows design calculations to be entered into the computer and the resultant design form to be displayed on the cathode-ray tube display device. Because the calculations are processed at computer speeds and as quickly displayed, the user is able to make adjustments in the design at a speed never before possible. In fact, several alternate designs can be made in the time it once took to develop just one. Also, some of the devices now on the market will provide an image of the design in several different planes from several different angles. By viewing the design in all its variations, the artist/designer can quickly discern any potential problem areas, thereby reducing potentially disastrous loss of time and money.

This is one example of equipment and systems in transition. Present people-to-computer and computer-to-computer systems of virtually unlimited potential are being brought to use as the various technologies are developed.

Now we have developed the word and picture presentation of our information. The next step is publishing — the true catalyst of the information explosion.

Black and White and Color Copiers

A major factor in the manner in which information is processed from thought to the reproduced word and picture is the modern office copier. The rows of clerks typing five carbons each, or laboriously hand-copying material for a research project are gone forever. The copier provides the ability to quickly copy and distribute clean readable documents at a reasonable cost.

The ability to make low-cost copies of portions of business and technical reports has enabled information to be distributed to the user with an ease and volume approaching that of the printing press. Indeed, the 100 billion copy per year plateau has been reached in our society's ever-increasing hunger for more and more information.

Color copiers introduced in the past few years have enabled us to copy full-color pictures or color charts or technical charts with equal ease, thereby reducing by days the turn-around cycles dictated by previous systems.

All these favorable aspects of copier technology are partially offset by the proliferation of paper (those 100 billion pieces of paper mentioned above) and by potential violations of copyright laws. As with all technology, judicious use of this excellent and improving tool can eliminate, or at least minimize, these problem areas.

Reproduction Devices

Now that the words are written, pictures are drawn, and copies distributed and approved, we have to prepare the material prior to transmitting it. If we look at mass reproduction in the very broadest terms, there are two major processes of reproducing information we know as books, pamphlets, and periodicals. These are the offset press and micropublishing. Remember that there are other processes of recording information, but these two produce the greatest percentage. A reasonably cogent description of either process, much like word processing, would require hundreds of pages. Our purposes are served by a brief overview.

New generations of offset presses and press systems are being introduced to the marketplace in interesting quantities. That is, the selection of automated presses is finally sufficient to fit virtually everybody's needs. In particular, new paper path and ink/water ratios have upped quality and machine speeds.

Microforms

The paper and new press technology combination has given us a tremendous amount of flexibility in disseminating information. The problem, however, now becomes one in which the growth of information is more than we can handle in a paper and press technology. There is just no way that we can handle the information base in 10 years in paper form let alone a base quadruple today's by the year 2000. Luckily we are not faced with this dilemma; there are the various forms of microfilm to reduce this volume to a manageable level until such time as "bubble" computer technology can be developed to economically replace microfilm as a storage medium.

Micropublishing is a world unto itself. It is an extremely complex subject but one of major importance in information systems. Micropublishing is a marriage of traditional book/report publishing techniques with microfilm. It may be defined as the reproduction of data in miniature form on a film base. There are several methods of micropublishing — from COM, from a printed document, and in lieu of printing. All methods or combinations may be used as required. One very important aspect of micropublishing in addition to its low cost of producing multiple copies is the very high savings of file space. This cannot be ignored. For example, we have about 500,000 reports totaling about 70 million pages housed in two power files occupying 48 square feet of floor space in our library at the Westinghouse Nuclear Center in Monroeville. In traditional form, this number of pages would require more than 11,000 square feet of floor space or 35,000 file drawers. A considerable difference, I'm sure you'll agree. And the savings are not in raw space only, but in accessibility of the information and the ease with which the user (or information specialist) may store and retrieve this mass of data. Otherwise a large group of information specialists would be required to serve the needs of the business and scientific staff and the difficulties in duplicating material would be numerous. At present, we duplicate the microfiche report in about a minute for each requestor and retain control of the original. The sum of ease of handling, accessibility, reduced staff, and reduced space requirements equals more prompt, efficient and economical service!

Information Transmission Systems

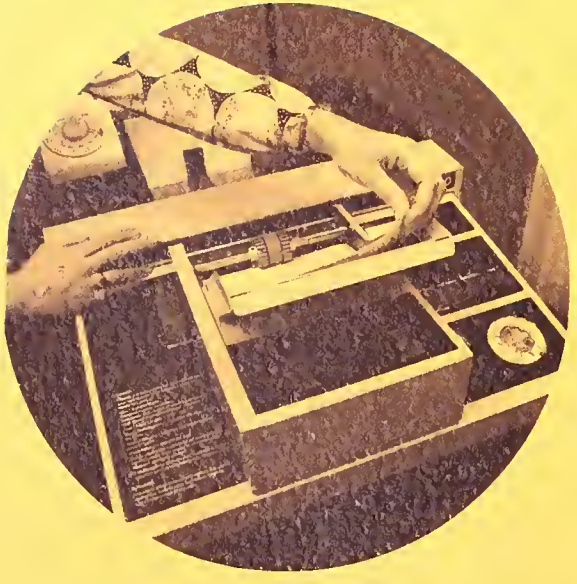
Information transmission systems take many forms. The following may be the most basic: a document is published; distributed by mail, parcel post or vehicle; received, say by a library; cataloged; computer-indexed; abstracted; and filed on a shelf. This is probably the most common means of information distribution or transmission. More up-to-date means of transmitting information are based on telephonic-type communication systems. These would include direct telephone connections for conversation and facsimile transmission, upgraded telephone lines for television-based systems, and very high quality lines for computer-to-computer and people-to-computer systems. The basic all-human-based systems are familiar to us all; the telephonic-system-based methods are not. Therefore, and because they are the base for future systems, we will consider only those systems based on the telephone line and microwave networks.

We are familiar with the telephone as an everyday convenience. We conduct social and business conversations many times daily. What is so special about the telephone? Really nothing without a device called an acoustic coupler that allows the telephone network — both domestic and international — to be used for exciting new concepts in communication. The acoustic coupler allows inexpensive devices using frequency generation systems similar to the telephone's to send coded messages over the telephone system; these are decoded at the other end. In more

permanent installations, hardwiring to the telephone system is done with a Data Access Arrangement (DAA) that permits either facsimile or voice use of the network.

Facsimile Systems

The facsimile transmission system was initially hardwired to a private system. After being adapted to the acoustic coupler, or to the DAA, it has proved to be a communicator's dream tool. Any 8½- by 14-inch page may be transmitted from one device to another in a matter of from 1 to 6 minutes, depending on the quality desired. The real value of facsimile is its capability to rapidly transmit an exact duplicate of a page that includes not only words but line drawings or photographs. The implications are staggering. An information scientist no longer must be at the source of data. If telephone links exist between a remote information repository and the scientist's office, he can receive data in no more than 6 minutes that previously would have taken days or weeks. Information gathering has been greatly simplified. Also, the potential for establishing electronic mail systems using private telephone lines is enormous. The combination of inexpensive telephonic costs plus the fax speeds of transmission is difficult to ignore. The uses are truly endless as are the distances, thanks to the communications satellites. Indeed, facsimile communication links were used during the Apollo space program linking the Earth and the Moon.



Remote Control and Still-Scan Television

Several television system concepts have been developed that are of interest to the communicator and especially to the information specialist. How often have we made the state-

ment, "How I wish I could see that (whatever) in position or operation!" One such concept involves remote control techniques. It is now possible to remotely control an encased television camera in virtually any environment — even the Moon's, thanks to NASA and the Apollo program. Transmission of the signal is usually to a video tape recorder where the electronic signals developed by the camera are stored on magnetic tape for later replay.

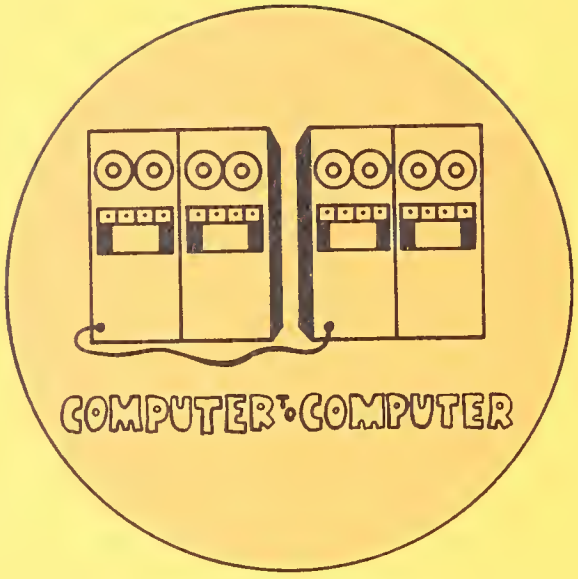
The other concept is Still-Scan (frequently referred to as Still-Frame) television. This is simply the transmission over telephone lines from station to station (again using the acoustic coupler) of a single picture frame taken by a television camera.

This concept is very similar to that of facsimile transmission but has one advantage — you can transmit a picture of anything the camera can televise. No longer are you restricted by size or immobility of the original.

These are interesting concepts just now becoming available as working hardware systems. Let your imagination roam for future applications in disseminating information via video systems.

Computer-to-Computer Systems

Using upgraded telephone lines — called data links — we are able to have information from all over the world at our fingertips. We also are able to send information all over the world. All we need is the information in computer-usable format, the data link, the access code to the computer at the other end, and a computer capable of accepting the infor-



mation to be transmitted. The possibilities of exchanging information rapidly and over long distances are mind-bending. Because much of the impact from this area will be exploited in the future, a detailed discussion will be presented in the section on future systems. Mention is made here because a few high-technology corporations and some federal government agencies routinely use such systems.

Information Storage Systems

Storage systems range from the very simple — shelves — to the very sophisticated — microfilm and computer-based systems. There are probably as many storage systems as there are information repositories using various combinations of standard library shelving, cataloging, and manual filing and retrieval; microfilm storage; and computer storage. None of the automated systems, however, can really be separated from the retrieval aspects of the information chain. Indeed, many people consider storage and retrieval a single function; this may well be correct for the very large systems and will be true for future automated systems. It has been truly stated that no purpose is served if the stored information cannot be retrieved and used.

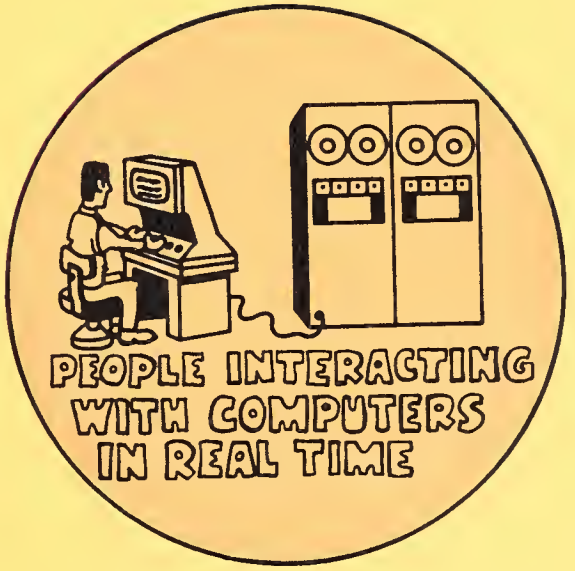
Information Retrieval Systems

As with storage systems, retrieval systems range from the very simple — someone removing a book from a shelf — to the very sophisticated — people-to-computer and microfilm/computer systems. The large microfilm bases controlled by

computers are in use today and offer the capability of handling not only alphanumeric information but also graphic information.

People-to-Computer Systems

It is well known that computers require esoteric languages to do our bidding. Terms such as COBOL, FORTRAN, BTAM, and QTAM are the everyday language of our computer brethren. This restriction has limited the use of computers in the area of information retrieval until recently. New developments in user/computer relationships have opened up the way for rapid retrieval of written information.



Several commercial and governmental organizations have developed excellent systems that permit an individual to talk in normal language with a minimum of code directly to the computer, which replies in normal language. As designed, it cannot be used for calculations or to view actual reports, books, or journals. The system permits a searcher to carry on a dialog directly with a computer, allowing him to browse through large files of document citations to find the ones he needs.

The user need not be an expert in either computers or information systems to use the system for his data needs. He uses natural language designed to minimize the need for special knowledge about the system.

The real benefit of this person-to-computer interaction is that information which previously took months to collect can

now be obtained in minutes. The implication is staggering as well as exhilarating.

Microfilm/Computer-Based Retrieval Systems

There are many systems on the market for retrieval of information in both written and drawn format. They range from the simplest to the most complex computer-controlled systems.

The most common problem of information retrieval is just locating your resource material in the file. The jumbled mess which is the usual file can be improved by using 16mm microfilm cartridges. These cartridges can contain up to 2500 images of 8½- by 11-inch pages but usually contain 2000 images — the equivalent of one full file drawer.

Special coding on the microfilm can be inserted for accessing data randomly using specialized equipment. This equipment provides high-speed access to multiple files. It isn't cheap in relation to the old filing system but the time saving and elimination of misfiles are worth the cost!

Books, periodicals, and reports — in other words most printed documents — usually contain both words and pictures. To best store this information in compact format that is economically retrievable, microfiche is utilized. A microfiche-based system is described under the Micropublishing section of the Generation portion of this chapter. Computer indexing improves access to the information contained in the microform.

Many large information centers, both private and public, use computer-controlled microfilm-based systems to store and retrieve their large collections of information. The reduced space requirements and ease of access to the information more than offset the costs of starting and operating this type of system.

For drawings, there is nothing like the super system we have at the Nuclear Center. The system allowed us to progress from an uncertain method of obtaining a drawing in up to 6 weeks to a positive system of viewing a drawing in 30 seconds. This system comprises a pushbutton telephone, audio response network, IBM 370-155 computer (small portion), Westinghouse 2550 minicomputer, and dualbank Infodetics 410 storage/retrieval system with on-line video cameras and microprinters. A user can access the system with his standard pushbutton telephone; in seconds he can have a variety of information about approximately 400,000 drawings. He can view a drawing on one of 29 video monitors or request that a print be sent to him. File integrity and accuracy of response are just two of many advantages of this system.

Summary

Most present systems for communicating ideas are based on manual procedures. Some mechanization has been adopted in the generation, transmission, storage, and retrieval aspects of the information chain. A few private industry, governmental agency and public sector information centers have adopted new techniques of handling information and are leading the way from systems based on manual procedures to systems based on microfilm and electronic systems. The transition is one in which 19th century techniques are in wide use, and 21st century systems are being anticipated and planned.

Potential Future Systems

Introduction

Potential information communication systems of the future offer such advanced features (compactness, portability, range, and accuracy) that the average layman, unfamiliar with present trends and levels of technology, is under the impression that a group of science fiction writers has escaped. To the professional information communication specialist, the trend is but another logical step in a long series.

Think for a moment about the claims made around 1970 as cable television was becoming widespread. Local newspapers and even the prestigious *New York Times* predicted a time when the home TV could be used for "home delivery of the day's news". As this paragraph is being written, the local cable outlet, channel 11, is providing me with news highlights, weather information, and music from a local FM station. Although this is not a complete confirmation of the prediction, it shows how far we've come in a nonprofit sector in less than 10 years, in an area where traditional patterns change ever so slowly.

The move from the home TV newspaper to the business information communications center (shall we refer to it as infocom?) is a small one from a technology viewpoint, but a large one in terms of cost to develop, implement, and operate. That is why progressive industry and government are now, and will be, the leaders in this area. Public demand to read the sports news at home – at a cost – will not soon rival the businessman's desire to review the latest business picture at his desk. By 1990, the first generation of the infocom centers will be in operation, interconnecting the users with their personal files, computers, libraries, and other data banks

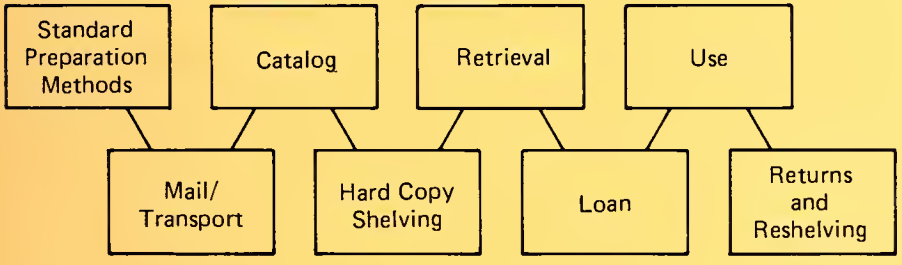
and with similar facilities at remote sites. In another 20 years, our home TV will indeed become an infocom center, connecting us not only to entertainment and news resources but to our financial and information data banks as well.

Our knowledge base moves us relentlessly on — on into partly unknown future systems so that we may complete the Communications Cycle. We are beginning to look at digitalized systems that will go instantaneously from one typewriter to another typewriter thousands of miles or even hundreds of thousands of miles away. Already, in sending information from Houston to the Moon during the Apollo program, the concept has been proved. Indeed, the communication links are capable of considerable lengthening; with relay bases (satellites) we could support interplanetary expeditions with all necessary maintenance and repair information from earth. Also, we are working on microfilm systems that can be scanned and transmitted digitally. Once economically and reliably developed, archival and on-line files of both alphanumeric and graphic nature will be microfilmed and retrieved automatically. Paper-based files as we know them will be a relic of the past, save in those organizations not adequately funded. If you feel that this concept is a bit farfetched, consider the number of good quartz digital wrist calculator/watches available for less than $500. Just 2 or 3 years ago these were seen only in comic strips or science fiction. But microchip electronic circuitry developments have made the dream a reality; the same is happening in the area of information-handling technology.

Although the number of potential systems is virtually limitless, we will describe some basic systems that could readily be applied to handling information.

Basic Existing Information Distribution

Once a book, periodical, or report has been printed, it is usually distributed via the mails or a mail-related system to a library or other information repository. The document is usually cataloged, shelved, retrieved, issued/loaned to a requestor, and reshelved when the user has satisfied his need for it. Each step is manual, and time- and space-consuming. There are better ways.

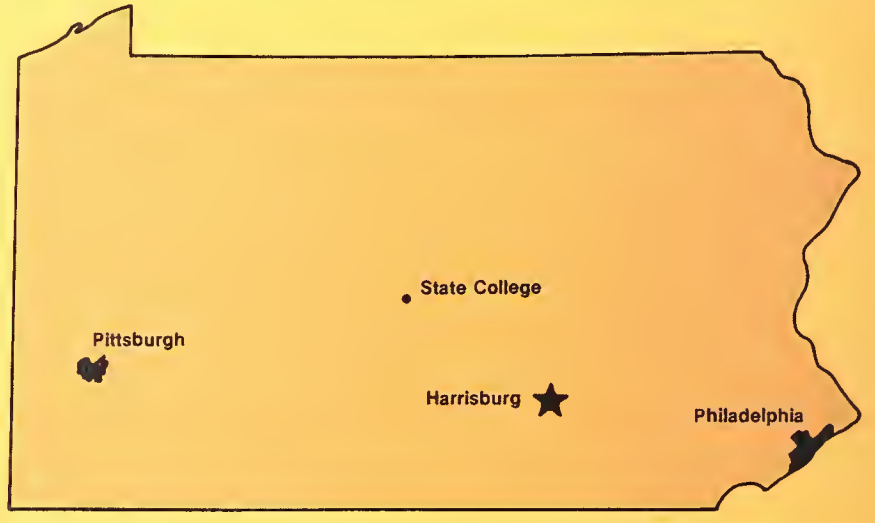


Potential Interlibrary Loan Systems

The present interlibrary loan system incorporates many features of the basic information distribution system. Library A receives a request for a book it does not have. A record is made of the request and the nearest appropriate resource center is contacted. A record is made there; the book is retrieved, logged out to Library A complete with a return due date, packaged, and mailed. When it arrives at Library A, it is unwrapped and logged in, and the requestor is notified that the book has arrived. When the requestor arrives to claim the book, the transaction is recorded. The dozen major steps described are all manual and relatively time-consuming. The following scenario is illustrative of time, cost, and space saving possibilities.

As alluded to on page 12, it should be noted that these two scenarios are portrayed apart from the impact of existing and new copyright laws which will have to be dealt with no matter the technology used to disseminate information.

The request is received at Library A, as before. The librarian calls the appropriate resource center and requests that the book be placed in the microfilm facsimile system. Approximately 3 to 5 minutes later a "throwaway" microfiche copy is received. Other than the automatic billing paperwork, prepared by the microfilm facsimile device, no other transactions are required. The microfiche copy of the book at the resource center was automatically retrieved and placed in the fax unit during the time Library A was on the telephone. The user never left Library A; service was virtually instantaneous.



PENNSYLVANIA REGIONAL LIBRARIES

Total cost of the present method of filling the request is about $25, including postage. This will vary, of course, according to location and to the time spent in locating the book. The potential system described could produce the

duplicated microfiche for about $1.00, not including the equipment investment in the storage/retrieval system. The cost savings per transaction, repeated thousands of times, quickly recover the initial and operating costs. The real saving and improvement, of course, is the ability to disseminate information rapidly.

A slightly different scenario involves the four regional libraries in Pennsylvania:

- Carnegie Library of Pittsburgh
- Free Library of Philadelphia
- State Library (Harrisburg)
- Pennsylvania State University Libraries

The person mentioned above again comes to Library A for a specialized subject book. In this case, the librarian is certain the information wanted is in the State Library. Quickly accessing the computerized holdings listing with a computer terminal, the librarian ensures that the information is indeed available. Next, a telephone request (or request via the computer terminal if we presuppose a touch more sophistication) to Harrisburg and the order is placed. A few minutes later, the first page of information arrives via facsimile; the remaining pages arrive at the rate of two per minute. The cost is about 5 cents per page, plus a $200 per month flat charge for each of the fax devices. A nominal charge in the smaller libraries could cover expenses. When the system is expanded to include the 27 district libraries, the resources of even the smallest rural library become equal in holdings to the sum of all the libraries in the state system.

A Multifunction System

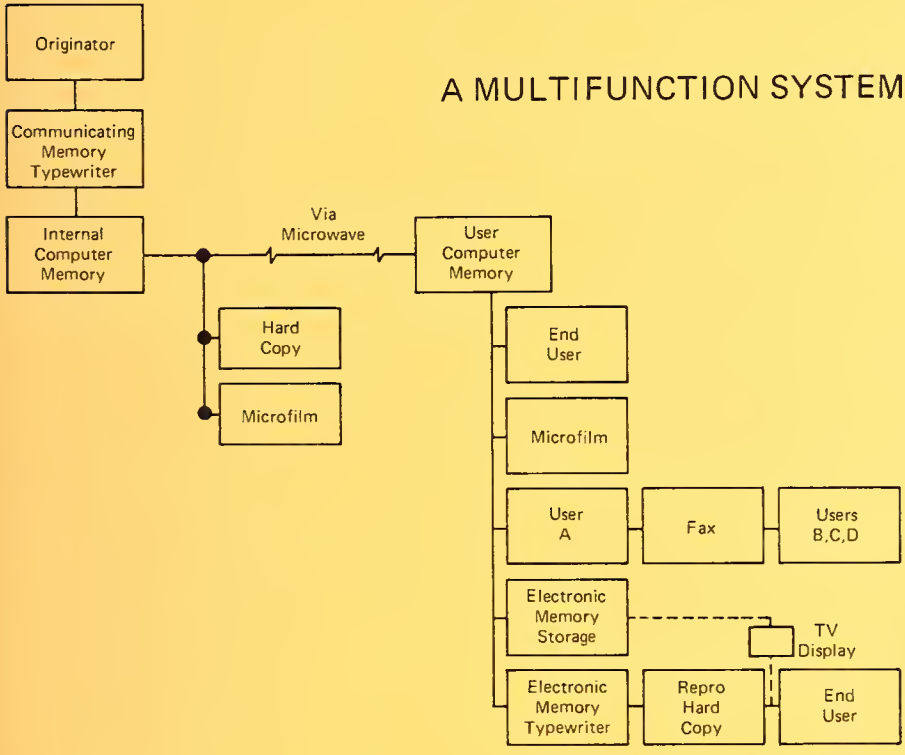
Information can be handled in many forms – paper, microfilm, magnetic tape – each serving a special purpose. Unfortunately this fact is neither widely known nor widely accepted, even though every piece of hardware for such a system exists and indeed is in daily use! This system, shown below, provides the user with the following:

- Hard copy at both ends
- Computer magnetic tape records at both ends
- Electronic floppy disk storage for automated typewriters
- TV display
- Facsimile distribution from selected pages
- Microfilm

Imagine that you have a large document due for submission to more than one recipient simultaneously and that the recipients are widely separated geographically from you and from one another. Time is short, delivery of information a must. Traditionally we have turned to the printed page and then worried about delivery method. Now, we can select from "dumping" our computer tape onto the recipients' computer tapes, delivery via fax, or "dumping" from our communicating word processor to their word processors to paper. Or, if we selected the computer tape to computer tape option, we can then have their computers produce printed pages or microfiche, all at speeds and costs much more attractive than those of the present systems. While the above process is in operation, our computer could be providing key information to our customers' TV display. The combinations

are almost endless, operate at mind-boggling speeds, and can be in place on a broad scale by 1985-90 on an economical basis.

A MULTIFUNCTION SYSTEM



Portions of the system could be adapted for interlibrary use, thus increasing by many orders of magnitude the information readily available to the general public at a cost the taxpayer can afford.

There are many more systems, but all contain features already described. An active imagination, a desire to innovate, and money are the ingredients required to design your own system. It is surprising how quickly the savings outweigh the costs, for the information not available on a timely basis is infinitely more expensive than any system to communicate ideas.

We have described briefly the history and possible future of communicating ideas. To repeat an old cliche, today is yesterday's future and tomorrow's past. To plan tomorrow's and tomorrow's past (future and present), we must plan today.

The major objective for information communication systems for the 1985-1990 time frame is ease of accessibility. Information must indeed be at our fingertips at home or in the office. At home, the telephone and TV provide two excellent basic access systems. In the office, every executive office will be fitted with a small TV/Touchtone telephone combination. This combination, with a knowledge of the correct access codes, will provide direct access to the company files, computers, personal files, and purchased information banks. The January 1977 issue of *Administrative Management* forecasts the automated office for the year 2000 but I am more optimistic. I believe that pressures exerted by the growing data base will be balanced by our ability to complete the third leg of the Communications Cycle before that date. We are developing the complex word processing, micrographic, facsimile, and video hardware now. By 1990, the results will be ease of access, and by 2000, the results will be ease of access and portability. New electronic communication control techniques will permit absolute multiband channel control at minimal cost. Then we will have met the challenge posed by the rate of increase of information.

About the Author

Ron Field is Manager, Communications Services, for the Water Reactor Divisions of the Westinghouse Electric Corporation. In this position, Mr. Field is responsible for communications and information support of the divisions. A graduate of the Pennsylvania State University, he is an Associate Fellow of the Society for Technical Communication and a member of the Trustee Division of the Pennsylvania Library Association. For 2 years he was president of the Murrysville (PA) Community Library Board of Trustees and for the past 4 years he has been a member of the ANSI Committee Z39 on Library Work, Documentation, and Related Publishing Practices. Mr. Field's activities have earned him a listing in the 16th edition of *Who's Who in the East*.

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